IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	**Mail Stop APPEAL BRIEF - PATENTS**
Tuqiang Ni et al.	Group Art Unit: 1792
Application No.: 09/788,365	Examiner: Rudy Zervigon
Filed: February 21, 2001	Appeal No.: Unassigned
For: GAS INJECTION SYSTEM FOR PLASMA PROCESSING	

THIRD APPEAL BRIEF

Mail Stop APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This appeal is from the decision of the Primary Examiner dated November 26, 2008, twice rejecting Claims 25, 28-36 and 38-45. A copy of Claims 25, 28-36 and 38-45 is provided in the Claims Appendix of this brief.

Appellants previously paid a fee of $500.00 for filing the Appeal Brief on December 6, 2005; and previously paid a fee of $500.00 for filing the Second Appeal Brief on January 16, 2007. Accordingly, Applicants are due a refund of $460, the difference between the $540 fee due and the $1000 previously paid.

The Commissioner is hereby authorized to charge any appropriate additional fees under 37 C.F.R. §§1.16, 1.17, and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800.

I. Real Party in Interest

The present application is assigned to Lam Research Corporation ("Lam"). Lam is the real party in interest, and is the assignee of Application No. 09/788,365.

II. Related Appeals and Interferences

Appellants' legal representative, or assignee, does not know of any other appeal or interferences, which will affect or be directly affected by, or have bearing on, the Board's decision in the pending appeal. However, a commonly owned application on appeal is Appeal No. 2008-6350 (Application No. 10/024,208), in which a published version of the present application is used as a reference.

III. Status of Claims

Claims 25, 28-36 and 38-45 are being appealed. Claims 1-24, 26, 27 and 37 have been cancelled.

IV. Status of Amendments

Claim amendments filed with an After-Final Amendment on August 21, 2008 were denied entry in an Advisory Action mailed September 2, 2008. The same claim amendments were entered on September 10, 2008, upon filing a Request for Continued Examination. No claim amendments have been filed subsequent to the non-final Official Action, mailed November 26, 2008.

V. Summary of Claimed Subject Matter

Claims 25, 28-36 and 38-45 are directed to a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing. Claims 25, 39, 41 and 42 are independent claims. A concise explanation of the subject matter defined in Claims 25, 39, 41 and 42, including references to exemplary locations in the specification and drawings, follows.

Claim 25 recites a gas injector (**22**; e.g., FIGS. 1 and 3A-3C; page 9, line 19; paragraph bridging pages 10-11) for supplying process gas to a plasma processing chamber (**10**; e.g., FIGS. 1 and 2A; page 9, lines 19-21) in which a semiconductor substrate (**13**; e.g., FIG. 1; page 9, line 9) is subjected to plasma processing. The gas injector comprises gas injector body (**40**; FIGS. 3A and 3B; page 10, lines 23-24) of dielectric material (e.g., page 10, lines 7-8) and is sized to extend in an axial direction through a chamber wall of the processing chamber (**20**; e.g., FIGS. 1 and 2A; page 9, lines 16-19) such that a planar distal end surface of the gas injector body (bottom surface of **40**; FIGS. 3A-3B) is exposed within the processing chamber (e.g., FIGS. 1-2). The gas injector body includes a bore (**44**; e.g., FIGS. 3A-3C; page 10, lines 24-25) defined by a cylindrical side wall and an endwall and a plurality of gas passages (**46**; e.g., FIGS. 3A-3C; page 11, lines 1-3) are in fluid communication with the bore (e.g., FIG. 3A). The gas passages are adapted to supply process gas into the processing chamber. The gas passages include gas inlets located in the endwall and gas outlets (**46**; e.g., FIG. 3A; page 11, lines 1-3) located in the planar distal end surface of the gas injector body (**40**; e.g., FIGS. 3A-3C). The total area of the gas outlets is less than the cross-sectional area of the bore. The gas outlets are sized to

inject the process gas at a subsonic, sonic or supersonic velocity (see, e.g., page 6, lines 2-3). The gas inlets are closer to a central axis of the bore than the gas outlets (e.g., FIG. 3A).

Claim 39 recites a gas injector (**22**; e.g., FIGS. 1 and 3A-3C; page 9, line 19; paragraph bridging pages 10-11) for supplying process gas to a plasma processing chamber (**10**; e.g., FIGS. 1 and 2A; page 9, lines 19-21) in which a semiconductor substrate (**13**; e.g., FIG. 1; page 9, line 9) is subjected to plasma processing. The gas injector comprises gas injector body (**40**; FIGS. 3A and 3B; page 10, lines 23-24) sized to extend in an axial direction through a chamber wall of the processing chamber (**20**; e.g., FIGS. 1 and 2A; page 9, lines 16-19) such that a distal end surface of the gas injector body (bottom surface of **40**; FIGS. 3A-3B) is exposed within the processing chamber (e.g., FIGS. 1-2). The gas injector body includes a plurality of gas passages (**46**; e.g., FIG. 3A; page 11, lines 1-3) adapted to supply process gas into the processing chamber and a cylindrical bore (**44**; e.g., FIGS. 3A-3C; page 10, lines 24-25) adapted to supply gas to the gas passages. The cylindrical bore is defined by a sidewall and an endwall which extends radially inwardly from the sidewall (e.g., FIG. 3A) and the gas passages include gas inlets located in the endwall and gas outlets located in the distal end surface (e.g., FIG. 3A). The gas passages include a center gas passage extending in the axial direction and a plurality of angled gas passages extending at an acute angle to the axial direction (e.g., FIG. 3A). The gas inlets of the angled gas passages are closer to a central axis of the bore than the gas outlets of the angled gas passages (e.g., FIG. 3A). An annular flange (**42**; e.g., FIGS. 1, 2, 3A-3B) has a surface (i.e., bottom surface) adapted to overlie and contact an outer surface of the chamber wall (i.e., top surface

of dielectric window **20**; FIGS. 1-2). A first O-ring (e.g., FIG. 1, page 10, line 26; page 13, lines 10-12) is in the surface of the flange for sealing against the outer surface of the chamber wall.

Claim 41 recites a gas injector (**22**; e.g., FIGS. 1 and 3A-3C; page 9, line 19; paragraph bridging pages 10-11) for supplying process gas to a plasma processing chamber (**10**; e.g., FIGS. 1 and 2A; page 9, lines 19-21) in which a semiconductor substrate (**13**; see, e.g., FIG. 1; page 9, line 9) is subjected to plasma processing. The gas injector comprises a gas injector body (**40**; FIGS. 3A-3B; page 10, lines 23-24) sized to extend axially through a chamber wall of the processing chamber (**20**; e.g., FIGS. 1 and 2A; page 9, lines 16-19) such that a distal end surface of the gas injector body is exposed (i.e., bottom surface; e.g., FIGS. 1, 2, 3A, 3B) within the processing chamber. The gas injector body includes a plurality of gas passages (**46**; e.g., FIG. 3A; page 11, lines 1-3) adapted to supply process gas into the processing chamber. The gas injector body includes a uniform diameter central bore (**44**; e.g., FIGS. 3A-3C; page 10, lines 24-25) adapted to supply gas to the gas passages. The central bore extends axially from an upper axial end face of the gas injector body (i.e., top surface of gas injector **22**; e.g., FIGS. 3A and 3B). The central bore is defined by a cylindrical sidewall (i.e., the axially-extending inner wall of the body **40**) and a planar endwall (i.e., the inner wall defining the lower end of the central bore **44**) extending between the cylindrical sidewall. The gas passages include gas inlets located in the planar endwall and gas outlets located in the distal end surface of the gas injector body (e.g., FIG. 3A). The gas passages are sized to inject the process gas at a subsonic, sonic or supersonic velocity (e.g., page 6, lines 2-3). The gas

inlets are closer to a central axis of the bore than the gas outlets (e.g., FIGS. 3A and 3B).

Claims 42 recites a gas injector (**22**; e.g., FIG. 1 and 3A to 3C; page 9, line 19, paragraph bridging pages 10-11) for supplying process gas to a plasma processing chamber (**10**; e.g., FIGS. 1 and 2A; page 9, lines 19-21). A semiconductor substrate (**13**; e.g., FIG. 1; page 9, line 9) is subjected to plasma processing. The gas injector comprises gas injector body (**40**; FIGS. 3A-3B; page 10, lines 23-24) made of a dielectric material selected from the group consisting of quartz, alumina and silicon nitride (page 10, line 7-8) and sized to axially extend through a chamber wall (**20**; e.g., FIGS. 1 and 2A; page 9, lines 16-19) of the processing chamber such that a planar distal end surface (i.e., bottom surface; e.g., FIGS. 1, 2, 3A, 3B) of the gas injector body is exposed within the processing chamber. The gas injector body includes a bore (**44**; e.g., FIGS. 3A-3C; page 10, lines 24-25) defined by a cylindrical sidewall and an endwall and a plurality of gas passages (**46**; e.g., FIG. 3A; page 11, lines 1-3) adapted to supply process gas into the processing chamber. The gas passages include gas inlets located in the endwall and gas outlets (**46**; e.g., FIG. 3A; page 11, lines 1-3) located in the planar distal end surface of the gas injector body (**40**; e.g., FIGS. 3A-3C). The gas passages are sized to inject the process gas at a subsonic, sonic or supersonic velocity (see, e.g., page 6, lines 2-3). The gas inlets are closer to a central axis of the bore than the gas outlets (e.g., FIG. 3A).

VI. Ground of Rejection to be Reviewed on Appeal

Claims 25, 28-36 and 38-45 stand rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Koshimizu (U.S. Patent No. 5,935,373) ("Koshimizu") in view of Su (U.S. Patent No. 5,589,002) ("Su").

VII. Argument

A. Legal Standards for Obviousness

Under 35 U.S.C. §103(a), the Examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. M.P.E.P. § 2142. For a proper obviousness rejection, the Patent Office must provide "some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness" and not "mere conclusory statements." *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741 (2007) (quoting *In re Kahn*, 441 F.3d 977, 988, (Fed. Cir. 2006)).

Furthermore, as stated in M.P.E.P. § 2145 (X)(D), a prior art reference that "teaches away" from the claimed invention is a significant factor to be considered in determining obviousness; however, "the nature of the teaching is highly relevant and must be weighed in substance. It is improper to combine references where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983).

B. Rejection of Claims 25, 28-36 and 38-45 Under 35 U.S.C. § 103(a) Over Koshimizu in view of Su

The Official Action has rejected Claims 25, 28-36 and 38-45 under 35 U.S.C. § 103(a) over Koshimizu in view of Su. However, the rejection is improper because: (1) Su teaches away from directing gas away from center point **21'**; and (2) the claim

feature of "a center gas passage extending in the axial direction" is missing from the combination of Koshimizu and Su.

1. Claimed Subject Matter

Independent Claim 25 recites, *inter alia*, a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing, comprising gas passages include gas inlets located in the endwall and gas outlets; wherein the gas inlets are closer to a central axis of the bore than the gas outlets (emphasis added). Claims 41 and 42 recite similar subject matter.

Independent Claim 39 recites, *inter alia*, a gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing, the gas injector comprising, gas passages including a center gas passage extending in the axial direction and a plurality of angled gas passages extending at an acute angle to the axial direction, wherein the gas inlets of the angled gas passages are closer to a central axis of the bore than the gas outlets of the angled gas passages

2. The Examiner's Position

The Official Action cites Koshimizu for disclosure of gas processing supply port **156** (Official Action at page 2, ¶3). The Official Action acknowledges that Koshimizu does not disclose all the features of independent Claims 25, 39, 41 and 42 (Official Action at pages 4-5, ¶ ii; at page 6, ¶ x), but cites Su for disclosure of gas distribution plate (FIGS. 1-7) with arcuate slots **22a'** and **22b'** (Official Action at pages 8-9, bridging paragraph). The Official Action further contends that the angle of arcuate slots **22**a' and **22**b' is a result effective variable (Official Action at page 8-

9, bridging paragraph). The Examiner also erroneously states that "Su clearly shows angled injection holes that face inward toward the central axis of the bore" (Office Action at page 10, lines 2-3).

The Examiner admits that Koshimizu fails to teach the 18 claim features listed at pages 4-8 of the Official Action but contends that Su cures such deficiencies for the reasons stated in the paragraph bridging pages 8-9 of the Office Action. The Examiner makes no attempt to justify the 35 U.S.C. § 103 rejection under the *KSR* guidelines outlined in M.P.E.P. § 2143 (A)-(G).

3. Su Teaches Away From Directing Gas Away From Center Point 21'

Su provides a disclosure that "arcuate slots **22**a' and **22**b' are shown formed in gas distribution plate **20'** with sidewalls sloped at an angle α with respect to the surface of plate **20'**, where angle α is at least 30°, but is less than 90°" (emphasis added) (column 5, lines 40-43). Su further discloses that "[t]he sidewalls of arcuate slots **22**a' and **22**b' are angled toward center point **21'** of gas distribution plate **20'** on the delivery side of the plate, i.e., the face of the plate facing the wafer to be processed" (emphasis added) (column 5, lines 44-48). Thus, Su provides a disclosure that the inlets (i.e., indicated by arrow labeled "Gas Flow" in FIG. 7) of slots **22**a' and **22**b' are farther away from center point **21'** than the outlets of slots **22**a' and **22**b' (FIG. 7).

Thus, Su teaches away from directing gas away from center point **21'**. As a result, even if Koshimizu and Su are combined in the manner as suggested by the Examiner, the claim feature of "the gas inlets are closer to a central axis of the bore than the gas outlets " is still missing.

4. Missing Claim Feature of a Center Gas Passage Extending in the Axial Direction - Claim 39

The Official Action acknowledges that Koshimizu does not disclose the claim feature of "a center gas passage extending in the axial direction" (Official Action at page 6, ¶ x). This is because Koshimizu discloses a gas port **156** which constitutes a bore open at each end, thus lacking an end wall with gas inlets in an end wall and gas outlets in a planar distal end surface. If the Examiner proposes to replace the port **156** of Koshimizu with the gas distribution plate of Su, the Official Action has not identified any structure in Su that corresponds to "a center gas passage extending in the axial direction." However, because the angled slots of Su are oriented away from the center point **21'**, even if Koshimizu is combined with Su as proposed in the Official Action, the results fail to produce the claimed gas injector.

Because a *prima facie* case of obviousness has not been established, Applicants respectfully urge reversal of the rejection of Claims 25, 39, 41 and 42 under 35 U.S.C. §103(a). Dependent Claims 28-36, 38, 40 and 43-46 are also patentable over the applied combination of references at least for the same reasons as those discussed above regarding Claim 25, 39, 41 and 42.

VIII. Claims Appendix

See the attached Claims Appendix for a copy of the claims involved in the appeal.

IX. Evidence Appendix

See attached Evidence Appendix for copies of evidence relied upon by Appellant.

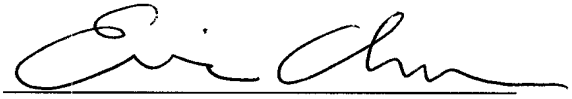
X. Related Proceedings Appendix

See attached Related Proceedings Appendix for copies of decisions identified in Section II, supra.

Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

Date: February 23, 2009

By: 

Eric B. Chen
Registration No. 52,725

P.O. Box 1404
Alexandria, VA 22313-1404
(703) 836-6620

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VIII. CLAIMS APPENDIX

The Appealed Claims

1-24 (Cancelled)

25. (Previously Presented) A gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing, the gas injector comprising:

gas injector body of dielectric material and sized to extend in an axial direction through a chamber wall of the processing chamber such that a planar distal end surface of the gas injector body is exposed within the processing chamber, the gas injector body including a bore defined by a cylindrical side wall and an endwall and a plurality of gas passages in fluid communication with the bore, the gas passages adapted to supply process gas into the processing chamber, wherein the gas passages include gas inlets located in the endwall and gas outlets located in the planar distal end surface of the gas injector body with the total area of the gas outlets less than the cross-sectional area of the bore and the gas outlets are sized to inject the process gas at a subsonic, sonic or supersonic velocity;

wherein the gas inlets are closer to a central axis of the bore than the gas outlets.

26-27. (Cancelled)

28. (Previously Presented) The gas injector of Claim 25, the gas passages include a center gas passage extending in the axial direction and a plurality of angled gas passages extending at an acute angle to the axial direction.

29. (Previously Presented) The gas injector of Claim 25, wherein the gas injector includes a planar axial end face which is dimensioned so as to be flush with an interior surface of a dielectric window forming the chamber wall.

30. (Previously Presented) The gas injector of Claim 29, wherein the gas injector includes at least one seal adapted to contact the dielectric window when the gas injector is mounted in the dielectric window.

31. (Previously Presented) The gas injector of Claim 25, wherein the gas passages include a plurality of angled gas passages which inject process gas at an acute angle relative to a plane parallel to the distal end surface.

32. (Previously Presented) The gas injector of Claim 25, wherein the gas injector is adapted to be removably mounted in an opening in the chamber wall and includes at least one O-ring providing a vacuum seal between the gas injector and the chamber wall.

33. (Previously Presented) The gas injector of Claim 25, wherein the gas injector body includes a surface adapted to overlie an outer surface of the chamber wall.

34. (Previously Presented) The gas injector of Claim 25, wherein the gas injector body includes an annular flange adapted to overlie and contact an outer surface of the chamber wall.

35. (Previously Presented) The gas injector of Claim 25, wherein the gas injector body includes at least one O-ring seal on an outer surface of the gas injector body.

36. (Previously Presented) The gas injector of Claim 25, wherein the gas injector body includes a first O-ring seal on an outer surface of the gas injector body and a second O-ring seal in a surface of a flange extending from the outer surface of the gas injector body.

37. (Cancelled)

38. (Previously Presented) The gas injector of Claim 25, wherein all of the gas passages supply process gas through the distal end surface of the gas injector body.

39. (Previously Presented) A gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing, the gas injector comprising:

gas injector body sized to extend in an axial direction through a chamber wall of the processing chamber such that a distal end surface of the gas injector body is exposed within the processing chamber, the gas injector body including a plurality of

gas passages adapted to supply process gas into the processing chamber and a cylindrical bore adapted to supply gas to the gas passages, the cylindrical bore being defined by a sidewall and an endwall which extends radially inwardly from the sidewall and the gas passages including gas inlets located in the endwall and gas outlets located in the distal end surface, the gas passages including a center gas passage extending in the axial direction and a plurality of angled gas passages extending at an acute angle to the axial direction, wherein the gas inlets of the angled gas passages are closer to a central axis of the bore than the gas outlets of the angled gas passages;

an annular flange having a surface adapted to overlie and contact an outer surface of the chamber wall; and

a first O-ring in the surface of the flange for sealing against the outer surface of the chamber wall.

40. (Previously Presented) The gas injector of Claim 39, comprising a second O-ring seal on an outer surface of the gas injector body.

41. (Previously Presented) A gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing, the gas injector comprising:

a gas injector body sized to extend axially through a chamber wall of the processing chamber such that a distal end surface of the gas injector body is exposed within the processing chamber, the gas injector body including a plurality of gas passages adapted to supply process gas into the processing chamber, wherein the gas injector body includes a uniform diameter central bore adapted to supply gas

to the gas passages, the central bore extending axially from an upper axial end face of the gas injector body, the central bore being defined by a cylindrical sidewall and a planar endwall extending between the cylindrical sidewall and the gas passages include gas inlets located in the planar endwall and gas outlets located in the distal end surface of the gas injector body, the gas passages being sized to inject the process gas at a subsonic, sonic or supersonic velocity, wherein the gas inlets are closer to a central axis of the bore than the gas outlets.

42. (Previously Presented) A gas injector for supplying process gas to a plasma processing chamber wherein a semiconductor substrate is subjected to plasma processing, the gas injector comprising:

gas injector body made of a dielectric material selected from the group consisting of quartz, alumina and silicon nitride and sized to axially extend through a chamber wall of the processing chamber such that a planar distal end surface of the gas injector body is exposed within the processing chamber, the gas injector body including a bore defined by a cylindrical sidewall and an endwall and a plurality of gas passages adapted to supply process gas into the processing chamber, wherein the gas passages include gas inlets located in the endwall and gas outlets located in the planar distal end surface of the gas injector body and the gas passages being sized to inject the process gas at a subsonic, sonic or supersonic velocity;

wherein the gas inlets are closer to a central axis of the bore than the gas outlets.

43. (Previously Presented) The gas injector of Claim 28, wherein the gas injector body includes 8 of the angled gas passages.

44. (Previously Presented) The gas injector of Claim 28, wherein the acute angle is 10 to 70°.

45. (Previously Presented) The gas injector of Claim 28, wherein the angled gas passages direct the process gas such that the process gas does not flow directly towards a substrate being processed.

IX. EVIDENCE APPENDIX

None.

X. RELATED PROCEEDINGS APPENDIX

None.